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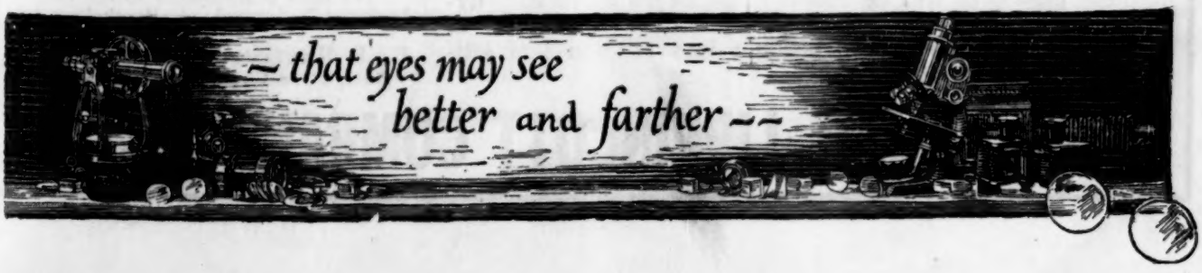

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VOL. LVII JANUARY 19, 1923 No. 1464

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

100 Liberty St., Utica, N. Y. Garrison, N. Y.

New York City: Grand Central Terminal

Annual Subscription, $6.00 Single Copies, 15 Cts.

Entered as second-class matter January 21, 1922, at the Post Office at Utica, N. Y., Under the Act of March 3, 1879.

THE DRY-ROT OF OUR ACADEMIC BIOLOGY[1]

OUR society requires its retiring president to close the annual meeting with a discourse or sermon—a task which has become increasingly difficult, for every year the program of the morning and afternoon sessions becomes more abstruse and therefore makes greater demands on our attention and the lingering memories of past presidential rhetoric invite to more odious comparisons. To me the task was the more arduous, because I had been busy for many years in remote fields of entomology in which few of you are interested, and because it fell to me at an inopportune moment, while I was in the very act of laying—if you will pardon a French expression—a volume of some 1,100 pages on ants. This racking oviposition leaves me reduced to a mere blob of corpora lutea and so feeble that I can only crawl, in search of a text for my sermon, to the next Encyclopedia Britannica article, which is not "ant-eater," but "Antæus." You will recall Antæus, that mythical F_1 generation hybrid between Poseidon, the Sea, and Gaia, the Earth. His hybrid vigor was so great, we are told, that he not only grew to gigantic stature, but insisted on wrestling with every stranger that happened to pass through his Libyan domain. He was always invincible in these encounters because his strength waxed with each successive contact with his mother Earth. When not engaged in wrestling he was building a monument to his father with the skulls of the vanquished. One day Hercules came along and, knowing the secret of the giant's strength, raised him aloft and strangled him in the air.

We may, perhaps, interpret this exploit of the sun-god Hercules as a mythical expression of the fact that no terrestrial substance can permanently resist evaporation or volatilization by heat, but the accepted and, I believe, more

[1] Address of the president of the American Society of Naturalists, Boston, December 29, 1922.

manifest meaning of the myth is that even an agile and vigorous mortal had best keep his feet on the concrete if he wishes to avoid death at the hands of the Hercules of abstraction. That the myth is of rather late origin would seem to be indicated both by this somewhat sophisticated interpretation and by the fact that the slaying of Antæus was not one of the twelve great labors of Hercules, but one of his Parerga, or deeds done by the way. The athletic demigod, while sprinting across the Sahara to get the golden apples of the Hesperides, merely stopped for a few minutes to finish Antæus. One might conjecture that the myth had been invented by some malicious Athenian potter or weaver, who, happening to live next door to the Academy, had often been annoyed by the "hot air" emanating from that institution, were it not that an Antæus-Hercules wrestling bout is known to have been a brilliant scene in one of the lost dramas of Phrynichus, written about 500 B. C.[2] Nevertheless, the myth remains to this day as one of the most beautiful expressions of the practical man's attitude toward those who place too much confidence in their more abstract intellectual operations.

After securing this text there was difficulty with the title of my sermon. I could not decide whether to call it the "tommy-rot" or the "dry-rot" of our academic biology. I finally chose the latter, because some of our activities so closely resemble the inroads of the fungus *Merulius lacrymans* in old timber, and because it might be amusing to find that the conscientious cataloguers of the Widener Library had included my effusion under cryptogamic botany or phytopathology. Imagine the hilarity of some young foot-ball player in the year of our Lord 1952, condemned to bone up for a final exam, and happening on a reprint of this paper reposing unashamed between such monuments of cryptogamic erudition as the 74 folio volumes of Professor Farlow's "Toadstools of God's Footstool" and the 27 quarto volumes of Professor Thaxter's "Laboulbeniales of the Universe"—like a naughty tick pressed between the hide of some royal Siamese she-elephant and that of her suckling daughter!

Text and title having been selected, auto-psychoanalysis, which, like prayer, is now one of my favorite diversions, revealed the fact that I was suffering from an acute, repressed desire to commit sabotage on our academic biology by hurling a monkey-wrench into its smug machinery. Since, according to the Freudians, such desires simply must be satisfied, and since I may never have another opportunity to hit so many of the wheels with one shot, I can see no reason why I should not obtain all the catharsis to which psychopathology entitles me. My mental condition is, no doubt, partly due to the disappointing spectacle of our accomplishments as more or less decayed campus biologists in increasing the number, enthusiasm and enterprise of our young naturalists. I estimate that at least 25 per cent. of all students graduating from our colleges have had the equivalent of an elementary course in zoology or botany.[3] There must be many thousands of these young men and women in the country and yet, in a prosperous population of 110,000,000, the number with a vital and abiding interest in biological inquiry, even as an avocation, is extremely small. And in our universities, apart from the students preparing to enter medicine, the number indulging in advanced and graduate courses in the science would probably shrink to zero if we failed to provide fellowships or to hold out to them at the end of a long pole that enhaloed bundle of hay, the doctor's degree.

Is this situation due to the moronic ignorance or the satanic machinations of our trustees, presidents and deans? I take down Professor Cattell's illuminating monographs on the taxonomy and behavior of this fauna, but can not find that it is to blame. Is it the fault of the students? Obviously not, for no coun-

[2] One may also conjecture that the story of Antæus is a very ancient but much distorted vegetation myth. It certainly resembles the myths of the Phrygian Lityerses and the Lydian Syleus. Both of these vegetation gods compelled strangers to compete with them, the one in the corn-field, the other in the vineyard, and both habitually slew their competitors and were in turn slain by the passing Hercules. See Frazer, "The Golden Bough," abridged ed., 1922, pp. 425, 442.

[3] *Cf.* the very temperate article by Professor H. H. Nininger, "Zoology and the College Curriculum," *Scient. Month.*, 16, 1923, pp. 66-72, an article which I did not see till after the delivery of my address.

try produces a greater and more sweetly docile mass of pedagogical cannon-fodder. It would seem, therefore, that the teaching of biology should not be entrusted to those whom Bismarck called the damned professors, or that there is something wrong with us who try to teach the science, or with the environment in which we carry on the business. I can not avoid the impression that the problem involves, in varying degrees, all three of these factors. Of course, their adequate discussion would be extremely wearisome. I can only pull out little mycelial tufts of *Merulius lacrymans* here and there and submit them to your inspection as evidence of the dry-rot which seems steadily to be invading the underpinning of biology, at least in some of our eastern universities. If you can bear with me, after a day of strenuous attention to far worthier utterances, I shall first consider very briefly some of the disabilities, both material and personal, under which we seem to be laboring, and in conclusion suggest what I believe might be an ameliorative if not a remedial plan of action.

The hampering effects of the material and environmental conditions under which we strive to inspire the young to become life-long naturalists deserve more attention than they have received. Any one of us who endeavors to grasp with his poor intellect, enfeebled by years of gyration in the academic mill, the stupendous and confusing accumulation of facts, not to mention the assumptions, fictions, hypotheses, theories and dogmas that make up present-day biology, must be staggered by the difficulty of selecting the most appetizing, concentrated and nourishing food for the student just entering the academic cafeteria. Perhaps no other collegiate department is expected to deal with such a vast and heterogeneous wealth of potential pedagogical pabulum. And the difficulty is greatly increased by the fact that one and all of us are highly specialized cooks, who delight in feeding the young on the dishes we ourselves like or that mother used to make and incidentally in showing our fellow cooks what delicious messes we can prepare. The student's metabolism may require plain gruel and toast, but we often insist on filling him up with so many elaborate pastries and salads that we ruin his digestion and, what is a thousand time worse, his appetite. Please bear in mind that I am trying to discuss the very practical business of teaching, not research. I am, of course, a ritualistic, high-church, port-and-sherry-loving Episcopalian in research, but only a poor, Peruna-soaked Methodist when it comes to teaching. I would go to such absurd lengths in helping research that I would even provide a room in the very modest institution to which I belong for any young man who might wish to spend the next ten years of his life investigating, say, the nucleololus of the fourth cell from the end of the last caudal cartilage of the embryo chipmunk, and if his work became very absorbing and his digestion impaired, I should be willing to feed him through a tube in the wall till his head swelled to the size of the room and he believed that he had become the nucleololus of Betelguese, but I should not permit him to see, much less converse, with freshmen. Such a pearl should not be cast before swine.

We might regard it as a great handicap that we academic biologists, unlike our native woodchucks and muskrats, are compelled to be most active pedagogically during the annual glacial period, but our superior intelligence enables us to cope with that situation. Every autumn we lay in a few cans of soused dog-fish and pickled sea-cucumbers, coop up some guinea-pigs, earth-worms, cockroaches and fruit-flies, throw in a bag of beans and several bales of hay for the botanists—and we are prepared for the worst. We can now proceed to disentangle and unreel the infinite and ineffable complexity of organic reality. We have more than enough for the purpose, for were we not all taught in our childhood by some old maid with ringlets that any little flower, or any little bug, for that matter, plucked from the crannied wall and held in the hand, is sufficient? When the neophyte becomes nauseated with the mess we have provided we can encourage him and incidentally heighten our own prestige by telling him that he is learning to forecast and control the behavior of organic nature, that he may shortly be able to make real live homunculi and regulate their mating habits, and all the pishpash with which, since the Neolithic Age, other priests and other wizards have heartened their constituencies.

More important than the drawbacks I have hinted at are certain types of personality en-

gaged in the business of teaching biology. Since the inquiring scientist insists on poking his nose into every fold of reality, and since biology professors constitute a part, and, in their own estimation at least, an important part of reality, we might expect them not only joyfully to investigate the behavior of their colleagues—they do this already—but also to submit themselves to investigation, with at least a show of good grace. What startling results we might hope to obtain from a thoroughgoing application of the Freudian and Adlerian analyses and the intelligence tests! But even if we concede that the damned professor is an extraordinary being because he has sufficient inertia to specialize for a life-time in a particular department of learning, we must admit that he will grow old like the most ordinary individual of his species. He will gradually take on most or all of the stigmata of gerontic involution, which Dr. G. Stanley Hall has enumerated. At forty, if not sooner, his sense-organs, musculature, endocrines, emotions and memory will begin to atrophy and his intellectual processes will become more and more stereotyped, dogmatic and abstract. From a young Antæus continually gaining fresh strength from each successive contact with concrete reality he will become a creature increasingly infatuated with generalizations, relationships and hypothetical explanations, especially if they are of his own confection, and he will eventually drift into a stage in which words, formulæ and imaginary entities become the very breath of his nostrils. He has been borne aloft to be slowly asphyxiated in the tenuous atmosphere of the unreal. There are, of course, all degrees of the process and it is so gradual that it may completely escape even a professor. One rather mature student, who had spent four years in a divinity school, recently told me that, having outgrown theology, he had entered the course of one of our eminent geneticists, a man capable of twisting one's head off, were one to insinuate that he had ever released his feet from the concrete. A few weeks later the student quietly dropped the course and when asked the reason replied that the professor's mental processes were so similar to those of his decrepit divinity teachers when they held forth on predestination, salvation through grace, infant damnation, and the like, that he had decided not to add a fifth year to his theological training.

Unfortunately we have no intelligence tests for individuals with a mentality of more than 18 years, and biologists are supposed to be older, though some of them somehow manage to harmonize a physical age of 40 to 60 with a mentality of 8 to 14. These, however, if really human and endowed with a decorative personality, seem to make the best teachers, probably because they enter most readily into mental rapport with the freshmen and sophomores. It is not from such professors that the Merulius spores proliferate most profusely, but from those who have a physical age of 40 to 60 and a mental age of 80 to 105.

I do not wish to be misunderstood on this matter of aging. Those of us whom the gods have not sufficiently loved to remove early in life all develop what might be called the normal inferiority complex of senescence, but we rationalize and compensate or even overcompensate for it. This is apparent in all the discussions of the subject from the remarks of the aged Cephalus in the prologue of Plato's "Republic" and Cicero's "De Senectute" to the very recent essay of the still delightfully youthful Professor Jennings "On the Advantages of Growing Old." La Rochefoucauld put the matter concisely when he said that "old men are fond of giving good advice in order to console themselves for being no longer able to serve as bad examples." As youngsters we are all filled with a spirit of adventure and long to dominate reality; later, after we have worn down our eye-teeth on its resistant carapace, we try to compromise with it by cajolery, and when this, too, fails, we forsake it and create a reality of our own, a realm of ideas, Platonic, esoteric, inviolable, eternal, in which we can still exercise the meager remnants of our will to power. This type of senescent compensation is most beautifully displayed in the sheltered environment of our universities, and I would not underestimate its enormous value to science and therefore to the race. It is clearly exhibited by old or prematurely old taxonomists, morphologists and geneticists, who derive from static fictions like species, unit characters, genes, etc., a certain feeling of potency, of having their fingers on the very vitals of organic reality. Many of

our most revered biological hypotheses are the work of senescents who have been sufficiently industrious and ingenious to make their subconscious compensatory strivings tally with very considerable bodies of facts. It would be interesting to ascertain the precise age, conditions of the sense-organs, endocrines, etc., of men like Darwin, Spencer, Galton, Weismann, Bruecke, Naegeli, Haeckel, Jaeger, Altmann, Wiesner, Haacke, Brooks, Verworn, DeVries, Hatschek and Johannsen, when they first began to operate with pangens, biophors and similar ultra-microscopic flora. We might also need the cephalic index, since certain racial tendencies may be involved. This is suggested by the fact that the French and Italian biologists have rarely shown the slightest interest in the construction of such entities. Are these biologists deficient in imagination or analytical power? Hardly. Or must we assume that the French and Italians, after having produced so many of the great scholastics, have lost confidence in their methods of dealing with the phenomenal world?

Undoubtedly the best culture medium for the academic dry-rot fungus consists of about equal parts of narrow, unsympathetic specialization and normal or precocious senile abstraction; and as this medium is always present in many personalities that find their optimum environment in our universities, the outlook is depressing. A friend who has long been studying our institutions of learning maintains that our only salvation lies in discharging all our faculties and burning or thoroughly disinfecting all the buildings every 25 years. I am somewhat less pessimistic, for although I have seen very little improvement in pedagogical method in our biological departments during the past 35 years, the stress they have laid on research has preserved them from the hopeless mummification that has overtaken some of the other departments.

It seems to me that there are two periods when the young biologist is most susceptible to lethal infection by the Merulius spores that are continually being thrown off by his professors. One is his freshman year, when he should be stimulated to develop an enthusiastic, receptive attitude, the other his graduate year or years, when he may be expected to adopt an independent, adventurous and creative attitude toward his science. Of course, the treatment of advanced students is easy for any professor who will follow the excellent example of the late Professor Roland of Johns Hopkins. The story is told that he was once presented with a list of rules for teaching graduate students and that he crossed out all the items and wrote beneath: "Neglect them!" Despite this very convenient precept, many of us coddle our graduate students till the more impressionable of them develop the most sodden types of the father-complex. Some of us even wear out a layer of cortical neurones annually, correcting their spelling and syntax. One fussy old guru of my acquaintance has destroyed both of his hemispheres, his corpus callosum and a large part of his basal ganglia hunting stray commas, semicolons, dashes, parentheses and other vermin in doctor's dissertations.

Not only do many of us wear out our most valuable tissues converting the graduate students into mere vehicles of our own interests, prepossessions and specialties but nearly all of us fail to excite in them that spirit of adventure which has in the past yielded such remarkable results in the development of our science. The finest example of this lack of vision is seen in the stolid indifference, especially in our eastern universities, to exploration and research in the remoter portions of our own country, in foreign lands and especially in the tropics. We have in the Philippines and at our very doors in the West Indies, Mexico, Central and South America the most marvelous faunas and floras in the world, but we still persuade our traveling fellows to cut more sections in the laboratories of Professor Rindskopf of Berlin or Professor Himmelschwanz of Leipzig, because thirty or forty years ago we were sent to the same *bemooste Häupter*. There was then a certain justification for this procedure because we at least picked up much valuable information from our fellow students in the *Bierstube*. But what shall we say to such dry-rot exhibitions as the following? A few years ago I was asked to secure a young botanist to accompany a biological expedition to the little-known Solomon Islands and therefore begged one of our eminent *exsiccati* to aid me in the quest. To my amazement he actually asked me whether I

did not know that New England was covered with a luxuriant and almost unknown flora and did not regard it as a crime to dissuade a young botanist from devoting his life to pressing the plants of Cape Cod! And yet the theory which has revolutionized all our thinking was brought to us from the tropics by two naturalist explorers, and for a century those who have presided over higher education in Great Britain, France, Germany and the Scandinavian countries have seized every opportunity to send their young biologists to the tropics. I refrain from wearying you with the long list of gifted European naturalists who, just before the war and throughout the tropics of both hemispheres, were increasing our biological knowledge by leaps and bounds. The neglect of our splendid opportunities has, in fact, become such a scandal that it is known even to our august band of Delphic hierodules[4] in crinolines, the National Research Council.

When we leave the advanced student and turn to the beginner, the picture is even more depressing. To us gerontic schoolmarms in trousers, who have flown from reality and have slowly succumbed to autistic thinking, with defective eye-sight, doughy musculature, brittle ossifications, demoralized intestines, decayed autonomic nervous systems and atrophied interstitials, there comes every year a small army of freshmen—very properly so called—in the late teens and early twenties, burning for impact with reality, with exquisite sense-organs, superb bones, muscles and alimentary tracts, mirific endocrine and autonomic apparatus and a mentality of nine to fourteen years, or thereabouts—and what do we give them? Perhaps we give them what they deserve for coming to us, but it might be more charitable to discuss what we do not give them. What portion of the science of life, that most concrete and most entrancing of all the sciences, ought we to administer to this suckling host of postadolescents? I answer: they should be fed during the first year on the simple oat-meal pap of ecology, but I hasten to declare that I do not mean the "ecology" of the zoologists, and especially of the botanists, of what Mencken calls the silo and saleratus belt of our great republic. For the sake of defining my meaning I shall have to make another tedious digression.

If, as some one has said, mathematics is the science that gives a single name to a great many different things, biology is certainly the science that gives a great many names to the same thing. This is an old story to the taxonomist, who, if he be worth his salt, will not only confer as many names as possible on every animal and plant, and change those of the commonest species every six months, in order to apprise other biologists that he is on the job, but he will also consign as many as possible of the other fellow's names—especially if he dislikes the other fellow—to the synonymy. I admire Haeckel, but I dislike his term "ecology" and have repeatedly pointed out that it belongs in the synonymy with a number of other terms, ranging in order of priority as follows: "natural history" (eighteenth and nineteenth centuries), "ethology" (Isidore Geoffroy St. Hilaire, 1859), "ecology" as "Relationsphysiologie" (Haeckel, 1866, 1869), "Biologie" in the restricted German sense (later nineteenth century to present), "bionomics" (E. Ray Lankester, 1889), "behavior," "comportement," "Gebaren" (past three decades). In this country the inept Haeckelian term, largely as a result of the afore-mentioned silo and saleratus botanists and their zoological camp-followers, has won the day and my adrenals are now too weak to offer further resistance.

Huxley, writing in 1879, apparently distinguished three ontogenetic and phylogenetic stages in the development of biology. He says: "Every country boy possesses more or less information respecting the plants and animals which come under his notice, in the stage of common knowledge; a good many persons have acquired more or less of that accurate, but necessarily incomplete and unmethodized knowledge, which is understood by Natural History; while a few have reached the purely scientific stage, and as Zoologists and Botanists, strive towards the perfection of Biology as a branch of Physical Science. Historically, common knowledge is represented by the allusions

[4] The definition of "hierodule" in the Century Dictionary is followed by the remark: "Large numbers of such slaves were attached to some foundations, and were either employed about the sanctuary or let out for hire for the profit of the god."

to animals and plants in ancient literature; while Natural History, more or less grading into Biology, meets us in the works of Aristotle, and his continuators in the Middle Ages, Rondeletius, Aldrovandus and their contemporaries and successors. But the conscious attempt to construct a complete science of Biology hardly dates further back than Treviranus and Lamarck, at the beginning of this century, while it has received its strongest impulse, in our own day, from Darwin."

This view of the matter is no longer adequate, quite apart from the fact that we are now entering on a fourth stage, a kind of metabiology, embracing biochemistry. The first of Huxley's stages, that of "common knowledge," should have been differently presented, in order to emphasize the practical, or economic source of the science in the activities and lore of the hunter, trapper, woodsman, herdsman, fisherman, husbandman, gardener, herbist, midwife, medicineman, etc. His second stage, that of "natural history," seems also to be presented in an adequate, if not misleading manner, probably because he was primarily a morphologist and somewhat dazzled by the fresh effulgence of the Darwinian theory of evolution, so that he seems to treat natural history not only as a transitional but also as a transitory phase in the development of biological science. History shows that throughout the centuries, from Aristotle and Pliny to the present day, natural history constitutes the perennial root-stock or stolon of biological science and that it retains this character because it satisfies some of our most fundamental and vital interests in organisms as living individuals more or less like ourselves. From time to time the stolon has produced special disciplines which have grown into great, flourishing complexes, and it has itself changed its name from time to time as the investigators of different periods have been impressed by different aspects of its fundamental tendencies. Aristotle wrote of the "histories" of animals, the naturalists of more recent centuries spoke of their "habits"; we have become more articulate and speak of their "behavior." Even a superficial acquaintance with the voluminous writings on natural history from those of the Stagirite to those of Gessner, Réaumur and Buffon and the naturalists of the first half of the nineteenth century, shows that for obvious psychological reasons human interest in organisms has always centered in their activities or what we now call their reactions to stimuli, their adjustment or adaptations to their environment and to one another. By the latter part of that pedantic century, the eighteenth, such great reserves of observation and experimentation had accumulated in the stolon that it began to bud. Taxonomy, morphology, paleontology, physiology began to shoot up, branch and differentiate, becoming independent specialties, developing their own methods, fictions and hypotheses. In the middle of the nineteenth century, after the great voyages of exploration, the bud chorology, or geographical distribution appeared, and about the same time I. G. St. Hilaire and Haeckel, wishing to emphasize the fundamental importance of adaptation, but mistaking the stolon for a bud, named it "ethology" or "ecology." More recently another dear little bud, genetics, has come off, so promising, so self-conscious, but, alas, so constricted at the base. And future centuries will no doubt witness a further gemmation of biological disciplines from the same old natural history stolon.

This is, of course, an extremely imperfect and summary sketch of the development of biological sciences, but it emphasizes the primitive, central and dynamic source of our interest in organisms. Obviously we can offer no criticism of those who prefer to call natural history or ecology "general" or "external physiology." Burdon Sanderson in 1894 presented the matter very concisely from this point of view in the following passage: "Now the first thing that strikes us in beginning to think about the activities of an organism is that they are naturally distinguishable into two kinds, according as we consider the action of the whole organism in its relation to the external world or to other organisms, or the action of the parts or organs in their relation to each other. The distinction to which we are thus led between the *internal* and *external* relations of plants and animals has of course always existed, but has only lately come into such prominence that it divides biologists more or less completely into two camps—on the one hand those who make it their aim to investigate the actions of the organism and its parts

by the accepted methods of physics and chemistry, carrying this investigation as far as the conditions under which each process manifests itself will permit; on the other, those who interest themselves rather in considering the place which each organism occupies, and the part which it plays in the economy of nature. It is apparent that the two lines of inquiry, although they equally relate to what the organism *does*, rather than to what it *is*, and therefore both have equal right to be included in the one great science of life, or biology, yet lead in directions which are scarcely even parallel. So marked, indeed, is the distinction, that Professor Haeckel some twenty years ago proposed to separate the study of organisms with reference to their place in nature under the designation of 'œcology,' defining it as comprising the relation of the animal to its organic as well as to its inorganic environment, particularly its friendly or hostile relations to those animals or plants with which it comes into direct contact. Whether with the œcologist we regard the organism in relation to the world, or with the physiologist as a wonderful complex of vital energies, the two branches have this in common, that both fix their attention, not on stuffed animals, butterflies in cases, or even microscopical sections of the animal or plant body—all of which relate to the framework of life—but on life itself."

The stolonic relationship of natural history, or ecology to the other biological disciplines is of great theoretical and practical significance. Nearly all the important biological problems, especially of a physiological or morphological character, have arisen in the course of simple investigation in natural history and many of the more difficult of them have been turned over to the special disciplines for solution. On the other hand, the ecologist is continually drawing on the methods and resources of physiology, morphology, taxonomy, distribution, etc., in solving his own particular problems of adaptation and behavior. The most interesting and important of them relate, not to the reactions of organisms to their inorganic environment, but to their reactions to one another. As this matter, though very simple, is often misunderstood, you will pardon me for dwelling on it for a few moments. Since all organisms, either of the same or of different species, invariably live in relationships of dependence on or of cooperation with others, the ecologist is justified in regarding the whole living world as an intricate congeries of biocoenoses, or consociations, ranging in complexity from at least two to a great many organisms. Even genetics may be regarded as a department of ecology, which is striving to formulate the precise symbiotic relationships of the gametes to each other in the constitution of the zygote, and their reactions with the environment. Hence the problem of adaptation is not foreign to this discipline though it is at present either ignored, as Bateson implies, or expressed in terms that are unfamiliar to the ecologist and physiologist. Moreover, since human societies are very intimate and elaborate biocoenoses of individuals of the same species, psychology, sociology, economics, anthropology, ethnology, history, ethics, jurisprudence, government, hygiene, medicine, etc., are essentially ecological, for their central problems are behavioristic.

It follows from these considerations also that applied, or economic biology is merely applied ecology, as Forbes, Needham and others have repeatedly stated.[5] Whenever and wherever one

[5] *Cf.* the following passage by Professor J. G. Needham, *Science*, N. S., 49, 1919, p. 457: "Dr. Howard suggests that we give more time to taxonomy and ecology and less to physiology and genetics. This is a good suggestion. We are all out of balance. Some of our laboratories resemble up-to-date shops for quantity production of fabricated genetic hypotheses. Some of our publications make a prodigious effort to translate everything biological into terms of physiology and mechanism—an effort as labored as it is unnecessary and unprofitable. Why not let the facts speak for themselves? Our laboratories are full of fashions. They go from one extreme to another. In my high school days we learned systems of classification; in my college days we did nothing but dissecting; later came morphology and embryology, then experimental zoology, then genetics, and the devotees of each new subject have looked back upon the old with something like that disdain with which a debutante regards a last year's gown. Natural history and classification are perhaps long enough out of date, so that interest in them may again be revived. I hope so; for these are the phases of biology by means of which a youth is best oriented for more special work. Then, too, they are immensely practical.

of the organisms of a biocoenose happens to be man, we have an economic situation, and it is in the precise determination of the relationships thus developed that ecology celebrates many of its greatest triumphs. I need only refer to the great field of parasitology—the work on cestodes, trematodes, trichinæ, hookworm, malaria, yellow fever and all the other insect-borne pathogenic organisms, in bacteriology, phytopathology, economic entomology, etc., all work which does not transcend the concrete natural history or ecological level. And everything indicates that we are only at the beginning of the revelations and benefits which similar studies have in store for us. Surely the ecologist need not veil his face in modesty even in the presence of a Mendelian formula or a new Drosophila mutation.

Although I have left our lusty young freshmen out in the cold during this long harangue, I have not forgotten them. I repeat: what ought we to give them? I do not believe that we should inform them with the first crack out of the box that they are animals and descended from ape-like ancestors. This must come as a severe shock to any young *Boobus americanus* who has never had an opportunity to make the acquaintance of really high-class apes, like the chimpanzees recently studied by Wolfgang Koehler at the German Anthropoid Station on the Island of Teneriffe. The freshman should be gradually led through a sympathetic study of the lower organisms as marvelous centers of beautiful and dignified processes to a knowledge of his own animal respectability, descent and responsibilities. This, I am convinced, is not to be achieved by taking dead and more or less smelly crayfish, earthworms, starfish and cockroaches to pieces, because Huxley in 1879 intimated that it might be a meritorious occupation for the young, nor by a too immediate study of living forms so remote in the scale of being as the Protozoa, Coelenterates and plants. It would seem to be preferable to start with living animals somewhere in the middle or higher reaches of organic development—small vertebrates, mollusks, insects, arachnids—and to make them the objects of direct, simple, comprehensive observation and experiment, severely suppressing or subordinating all morphological details which have no immediate bearing on the study of their activities. Necropsies, autopsies and postmortems might be introduced with discretion, but only after the student has acquired an acquaintance with the life-histories and more obvious methods of growth of his organisms—with the aid of moving pictures, whenever necessary—their methods of locomotion, feeding, respiration, excretion, defense and concealment, their reactions to light, temperature, humidity, etc., and especially to one another, *i. e.*, their mating, oviposition, parturition, nidification, parental care, predatory, parasitic, symbiotic, gregarious and social behavior, etc. Simple experiments in genetics, regeneration of lost parts, etc., could be introduced, but without cytological lace and ruffles. The successful teacher of elementary mathematics does not overwhelm and confuse the student with all the known recondite properties of the triangle and circle. The freshman laboratory should be neither an animal morgue nor a herbarium, but a vivarium. Its teaching staff should be numerous, competent, enthusiastic and young and, in order that Merulius infection may be avoided, no old professor or weary research student should be permitted to enter it without a complete change of mental underwear and, I might add, without a few moments of silent prayer or meditation at the door. To the present depauperate glacial fauna of the laboratory, the perpetual rat-guinea-pig-frog-Drosophila *repertoire,* we should add many of the thousands of even more interesting organisms that will live and multiply in confinement, and—although I realize the great difficulties involved—some means must be devised for taking the students into the field more frequently, since it is impossible to reproduce and study the more complex biocoenoses under artificial conditions.

You will probably agree that such a program of freshman work as I have very hastily sketched could in adroit hands yield at least a vital part of the needed preparation, first, for men who will devote the remainder of their collegiate and postcollegiate lives to occupations foreign to biology, and such men, of course, constitute the majority of any freshman class; second, for men who are primarily interested in the "Geisteswissenschaften"—psy-

One has to deal with species, and must be able to recognize them; and all economic procedure is applied ecology."

chology, philosophy, history, economics, law, etc.; third, for men who will enter medicine and may therefore be expected to specialize mainly in morphology and physiology during the remainder of their college course; fourth, for men who may wish to specialize in other departments of applied biology, such as agriculture, forestry, economic zoology and botany, fish and game conservation, etc., subjects to which our present freshman biology is a hopelessly inadequate introduction; fifth, for the biological investigator and teacher, who can not be too quickly persuaded to assume the modern dynamic and experimental attitude toward his science. It is, of course, this new attitude, that many of us older men, trained during the late Victorian morphological boom, have difficulty in assuming, and that makes us so conscious of our inability to participate very effectively in the biological education of the present generation.

There is another suggestion I should like to make, in order that the freshman course may be preserved from the dry-rot, which may invade even the most dynamic type of instruction, and that is the utilization by the instructor of competent amateur naturalists as occasional assistants. This seems never to have been tried, except in some of our summer camps and marine laboratories, and the reason is obvious. The typical professor has about the same liking for the amateur that the devil has for holy water, and the amateur habitually thinks of the professor in terms which I should not care to repeat. You will find a choice collection of them in Mencken's writings. The truth is that the amateur naturalist radiates interest and enthusiasm as easily and copiously as the professor radiates dry-rot. For years I have taken a malicious delight in introducing amateurs to professors, because the behavior of the latter on such occasions yields a precise quantitative test of the amount of Merulius in their timber. Dear, old, mellow, disinfected professors of the type of Louis Agassiz, Asa Gray, Shaler, Hyatt and Ryder enter at once into sympathetic rapport with the humblest amateur, but the young or those of middle age are almost invariably more or less priggish, condescending or worse. Now there is an opportunity to develop a mutual understanding and respect in both of these parties, so essential to the development of biological science, if the young instructors will only welcome and encourage the cooperation of the amateur in interesting his freshmen. We have all known amateurs who could make an enthusiastic naturalist out of an indifferent lad in the course of an afternoon's ramble and, alas, professors who could destroy a dozen budding naturalists in the course of an hour's lecture. The instructor who would from time to time call in some of our talented ornithologists, herpetologists, entomologists, arachnologists and malacologists to assist him, both in the laboratory and the field, would himself profit greatly, the significant human contacts of the students would be multiplied and the amateur be given just the right environment in which to spread the divine fire of his enthusiasm.

And this brings me in conclusion to what is perhaps the main source of our failure in incubating naturalists, and that is our too highly specialized, or esoteric attitude toward organic nature. Whether we contemplate the whole or only some particular portion of the realm of living things, it eventually tends to become for us merely so much material to be used in the solution of the many tantalizing problems which it suggests. We are, indeed, obsessed by problems. No doubt this is the correct attitude for the seasoned investigator, and no doubt a certain spirit of skeptical inquiry should be cultivated even in freshmen, but surely we should realize, like the amateur, that the organic world is also an inexhaustible source of spiritual and esthetic delight. And especially in the college we are unfaithful to our trust, if we allow biology to become a colorless, aridly scientific discipline, devoid of living contact with the humanities. Our intellects will never be equal to exhausting biological reality. Why animals and plants are as they are, we shall never know, of how they have come to be what they are, our knowledge will always be extremely fragmentary, because we are dealing only with the recent phases of an immense and complicated history, most of the records of which are lost beyond all chance of recovery, but that organisms are as they are, that apart from the members of our own species, they are our only companions in an infinite and unsympathetic waste of electrons, planets,

nebulæ and suns, is a perennial joy and consolation. We should all be happier if we were less completely obsessed by problems and somewhat more accessible to the esthetic and emotional appeal of our materials, and it is doubtful whether, in the end, the growth of biological science would be appreciably retarded. It quite saddens me to think that when I cross the Styx, I may find myself among so many professional biologists, condemned to keep on trying to solve problems, and that Pluto, or whoever is in charge down there now, may condemn me to sit forever trying to identify specimens from my own specific and generic diagnoses, while the amateur entomologists, who have not been damned professors, are permitted to roam at will among the fragrant asphodels of the Elysian meadows, netting gorgeous, ghostly butterflies until the end of time.

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TENDENCIES IN AGRICULTURAL RESEARCH[1]

LAND rather than soil problems engaged the attention of our pioneer farmers. To them the passing of the public domain into private ownership meant much. It meant the conquest of the wilderness, the leveling of dense forest growth, the turning of prairie sods. It was the era of agricultural exploitation without the thought of climbing yields and of better races of plants and animals. The rugged faith and courage of the pioneer were pitted against a not over-friendly environment in the persistent building of an agricultural empire. But, while in the retrospect of the present day the outcome was predestined, the path of progress was beset with many difficulties and uncertainties. Despite these, an unending procession of home-seekers braved the perils and solitude of forest and plain, the human stream flowing on to the west to build, to sow and to harvest.

Scarcely more than one hundred million acres of our land surface had been transformed into improved land by the middle of the last century. In the following decade each year brought an addition of five million acres of improved land, a rate of progress temporarily halted by the tragedy of the Civil War. But the beckoning furrows lengthened and multiplied, and it was a poor year between 1870 and 1890 when the addition to our improved land area was less than ten million acres. In the thirty years following 1890 this area grew from about 360 to more than 500 million acres. The conquest is still to be completed, but the era of land exploitation as such has been well passed. Coincident with the development of our land resources the acreage of our staple crops grew by leaps and bounds. The area under hay and forage crops increased from about thirty millions in 1879 to about ninety-six millions in 1919. There was a corresponding increase from about sixty-two million to eighty-seven million acres in the case of corn, from thirty-five to seventy-three millions in the case of wheat, from sixteen to about thirty-eight millions in the case of oats and from fourteen to nearly thirty-four millions of acres in the case of cotton. The relative increase in the acreage of rye, potatoes, tobacco and rice was even greater. Increasing numbers of farm animals followed the expansion in the acreage of improved land. They brought, as did the expanding acreage, a great array of problems that insistently called for solution.

The pioneer farmer was chiefly interested in methods that promised the most effective utilization of the vast resources of our soils and forests. He reached out for more efficient tools as well as for more efficient plants and animals. The invention of agricultural machinery was stimulated by the apparently unlimited acreage and ready accessibility of agricultural land. Implements of tillage, as well as harvesting machinery, multiplied the labor resources of our farms. Improved transportation came with the reaching out of our railroad systems. Mechanical power was later added to our agricultural labor resources and land utilization soon assumed vast proportions. In response to the demand for more efficient plants and animals better varieties of plants were made available by importation and se-

[1] Address of the vice-president and chairman of Section O—Agriculture, American Association for the Advancement of Science, Boston, December, 1922.

lection. Improved types of animals were likewise brought in from foreign countries and an effort was made to adjust both plants and animals to their new environment. Variety tests among the more important crops, exhibits at local and state fairs, the organization of breed associations and feeding trials constituted the means of hastening the introduction and use of the more productive types of plants and animals. But the era of exploitation had to reckon with the very serious losses caused by insect enemies, plant and animal diseases, animal parasites and predatory and destructive animals. To the problem of large scale production there was added the problem of adequate protection against these enemies. The Hessian fly, the chinch bug, grasshopper, weevils of stored grain, the codling moth, plant lice and wire worms are but a few of the outstanding insect pests that menaced the prosperity of the pioneer farmer. Farm animals were similarly threatened by ticks, flies, lice, mites and intestinal parasites. Fungi and bacteria levied a heavy toll on both crops and animals. Rusts, blights, mildews and other diseases became quite destructive even though the extent of the losses caused by them were not always fully appreciated. Cattle fevers and plagues, the spread of bovine tuberculosis, the ravages of hog cholera and the far-reaching damage done by blood parasites constituted a tax that early farmers seemed unable to escape. Quarantine, crop rotations and preventive treatment brought at best only partial relief. They helped to bring out in bolder relief the need for the accurate study of the mysterious forces that cast their evil shadow on the farmer's industry and thrift. To the progressive farmer there came the growing conviction that the solution of many of his problems lay outside of himself. He came to feel in time that the organization of schools of agriculture would react favorably on the interests of American farming and would point the way to better methods of production. The organization of experiment stations was a logical outgrowth of our agricultural colleges. The Land Grant Act, signed in the dark days of the Civil War, created the state agricultural colleges, which prepared the way and trained the men who later formed the vanguard of our agricultural research.

Land utilization and the introduction of improved types of plants and animals were the outstanding features of American farming during the second half of the nineteenth century. During that time distinct progress was made in answering the more insistent questions of our agricultural industry. Feeding trials, variety tests, the analytical study of the soils and crops, rotation experiments and the study of the response obtained from applications of manure, fertilizer and lime became more and more common. The more exhaustive and discriminating study of the underlying principles had scarcely made itself felt. Through the general progress of science, the increased number of trained men and the more intelligent and generous public support, the opportunity became ripe for the more systematic organization of agricultural research. The new century thus brought with it the men and the resources for the comprehensive inquiry into other important phases of plant and animal production. Not content with the testing of empirical remedies, the entomologist attempted to gain an intimate understanding of the life history of insects, their response to changes in their environmental conditions, the nature and occurrence of insect parasites. The entomologist sought the aid of the chemist, the bacteriologist, the mycologist and the physicist. We learned to know about contact and stomach poisons and the reaction of insects to light, heat, humidity and the nature and supply of their food. The body of knowledge concerning insects assumed large proportions and was gradually organized to form the foundation on which systematic methods of eradication and control could be developed. Thus, sprays, dusts and fumigants, as well as parasitic insects and fungi, have helped to erect a more or less effective barrier against a menace that is never absent. In their efforts to minimize the damage done by microorganisms the bacteriologist, the botanist and the chemist found cooperation desirable and satisfactory. The development of resistant species of plants through selection and breeding offers more than a partial solution of a difficult problem. Similarly, resistance and

immunity against pathogenic organisms has been the outcome of the isolation and study of microorganisms, their food requirements, the changes produced by them in the culture medium and the relation to their host. Sera, vaccines, antitoxins and bacterins were added to the weapons of defense against the invisible destroyers. In a word, then, the pioneer stage in the development of American agriculture had sufficiently tested the resources of agricultural research to prove its effectiveness and its promise. The mining of plant food was still carried on extravagantly and on a vast scale, the herds and flocks still grew in numbers, land utilization and crop and animal production had found at least partial insurance against catastrophic losses.

The more constructive phase of our farming belongs distinctly to the present century. Soil exploitation is finding its counterpart in soil building. The continuous growing of a single crop has largely been abandoned through force of necessity. Wheat, corn, cotton, flax, tobacco and other crops refused to yield a profit when grown on the same land year after year. Diversification and crop rotations established themselves through the farmer's efforts to escape the ravages of economic insects and fungus diseases. They found justification, also, in that they permitted the more economic use of labor and equipment resources of the farmer. But the theory of crop rotations, the significance of plant associations, the relation of individual crops to the soil micro flora and the plant physiological reactions of individual crops were to be made the subject of study at a later date. To the earlier farmers the use of lime was well known. The nature of the changes produced by lime, its relation to soil texture and structure, its effect on soil microorganisms and its direct and indirect influence on the plants themselves were to offer an attractive problem to the soil investigator. The practice of green manuring had become well established in the second half of the nineteenth century. The significance of the biological fixation of atmospheric nitrogen and likewise the biological formation of ammonia and nitrates was pointed out in the last quarter of that century. There were, nevertheless, many questions related to the underlying principles and their application that were still to be answered. Thus, the occurrence and distribution of symbiotic and nonsymbiotic nitrogen-fixing bacteria, the effect of soil reaction, the influence of the soil solution and of other factors on their activities were still to be determined. The more effective and the more profitable use of green manures was made possible by the more exact information on the response of the green manure plants to their environment. The botanist, bacteriologist and chemist have all had a share in creating this more exact information. In the building of soil fertility artificial fertilizers have played an outstanding rôle. Agricultural research has been obliged to deal with almost innumerable questions that have arisen in the manufacture and use of such fertilizers. The influence of fertilizers on the nature and concentration of the soil solution, the absorption and adsorption of soluble salts in different soils, the exchange of bases, the losses of soluble salts, the influence of the soil solution on germination and plant growth, the relation of fertilizer treatment to the activities of soil microorganisms and many other problems have received the attention of the investigator. Soil research is thus engaged in a thoroughgoing examination of the constructive phases of soil utilization. This is distinctive of the present trend of agricultural research. In so far as it may be consistent with economic practice, the tendency will become more manifest toward the liberal use of commercial fertilizers, the accumulation of reserves of available plant food in the soil and the effective utilization of the circulating plant food capital in increasing the average yield per acre. The soil investigator is very far from content with the results already achieved. He is reaching out toward a better understanding of the functions of manganese, fluorine, iodine and silica (formerly regarded as purely accidental constituents of plants). He is trying to find out to what extent protozoa are a limiting factor in the transformation of plant food by bacteria. Soil fungi and nematodes are, likewise, being made the subject of study in an endeavor to interpret more clearly the outstanding facts of soil biology. All this must hasten the progress toward higher levels of production just as selection, breeding and protection among plants and animals must assure us of the more

effective utilization of our plant food resources. But there are other problems now coming to the fore in American agriculture that are offering themselves as a subject of fruitful research. We have come to agree that we must make better use of our food resources. Physiological research has pointed out to us that the blending of proteins and their derivatives, of carbohydrates, fats, minerals and accessory substances in the feeding of animals holds the promise of greater net profits to the livestock producer. The application rests on a body of knowledge slowly created and as yet not fully interpreted. We know something at least about the cleavage products of protein and of the analytical and synthetic processes occurring in the animal body. We have made more than a mere beginning in the study of internal secretions and their rôle in animal metabolism. The study of vitamines may have assumed unseemly proportions, but has none the less given us a rich fund of information. Animal nutrition has thus entered a new stage that points the way to the conservation of our food resources and their more effective use. Our knowledge of feeding stuffs appearing as industrial by-products has also become more exact. The protein and carbohydrate feeds represented by cottonseed, linseed and soybean meals, or peanut and copra cake, have certain limitations when their composition is considered. Other by-products, like bran, gluten feeds, dried beet pulp and molasses, are not always utilized to the best advantage. Research problems relating to both conservation and use are making a strong appeal to the investigator. The same may be said of the conservation and best use of hay, straw, cornstalks, sunflowers and other crop materials. The study of ensilage and the conditions under which it is produced has already yielded profitable returns. The investigator is now looking ahead to the more systematic study of our forage plants in order that a basis may be created for the more effective utilization of our pastures, ranges and forests.

Agricultural research is now concerning itself with the problems involved in the manufacture of what we might well term secondary agricultural products. These would include milk and its products, fruits, vegetables and their derivatives, meat products, starches, sugars, etc. We have traveled far along the road in our study of dairy products. We know much about bacteria and fungi more or less prominent in the manufacture of butter, cheese and fermented milk beverages. We have done almost as much in the study of fruit derivatives, such as marmalades, sugared fruits, dried fruits, etc., but many attractive problems are still before the investigator. This will apply also to vegetables and the other commodities already mentioned. The agricultural colleges and experiment stations, so generously supported by the tax-paying public, will be expected to lay more stress on the investigations of such manufacturing methods as would substantially reduce the terrific waste of food materials now constantly occurring in our fields, orchards and storehouses. For example, many millions of bushels of potatoes, sweet potatoes, apples, pears and peaches are allowed to decay because of the lack of facilities for their conservation. Much sugar and starch in inferior potatoes, fruit and berries should not be sent to glutted markets to compete with these ingredients in vegetables and fruits of better quality. As time goes on greater stress will be laid on the utilization of the sun energy stored in the cellulose of our corn stalks, straws and other now relatively worthless materials. Whether or not alcohol is the most promising successor to petroleum and its derivatives as a fuel for our motor-driven machinery, it is almost obvious that agricultural research will have to deal earnestly with the transformation of the now less valuable agricultural commodities into products possessing food, fuel or other value.

Agricultural research will reckon to an increasing extent with problems of storage and handling. Refrigeration has undoubtedly stretched our food resources, but there is need for research not only as to types and methods of refrigeration, but also on the effect of refrigeration on the market and food value of fruits, vegetables, meats and other commodities. Transportation offers certain research problems, for much of the food shipped by rail or truck is more or less extensively infected with bacteria and spores of fungi. Very extensive losses occur in transportation because of faulty cooling or handling. Our agricultural colleges and experiment stations will

be expected to turn their attention to these problems. The quality and quantity of food as affected by storage, handling, transportation and distribution will then be less adversely influenced. Another tendency quite manifest in agricultural research is that relating to the economic side of agriculture.

The producer of agricultural commodities is just beginning to recognize the intimate relation that exists between his farm operations and the trend and interplay of economic forces. It is dawning upon him that production costs, taxation, land tenure, imports and exports, transportation, cooperation and marketing are vital factors in the agricultural industry. As he thinks of these a host of questions arise before him and fill his mind with doubt and suspicion. It is but natural for him under such circumstances to turn to his agricultural college and experiment station and to ask for light and guidance. He is readily given the information that is available, but he is made to realize, at the same time, that our knowledge of agricultural economics is, at best, quite limited. It is a field for exploration and ready to yield some of its secrets to the student and investigator. Because of his close contact with his agricultural institutions, he feels that he has a right to ask for research that would remove his perplexities, free him from the burden of uncertainty and allow him and his fellow farmers to build hopefully on the solid foundation of exact knowledge. Obviously, then, research on agricultural economics is to occupy the attention of our agricultural colleges and experiment stations. Research projects in this field will multiply. A demand will be made on the agricultural colleges to train men for the carrying on of research in this field.

The higher standards of living adopted by the progressive element in our agricultural population are creating a demand for research in the fields of sanitation and hygiene. The water supply in rural districts, its chemical and microbiological qualities, its possible significance as a carrier of pathogenic organisms, and its treatment and purification may be made the subjects of experimental study. The construction of septic tanks and of filter beds in connection with the disposal of household wastes, the mineralization of organic matter in sewage and the biology of sewage disposal on the farm present certain research problems. Flies and mosquitoes are not only a source of discomfort, but are potentially dangerous as carriers of disease organisms. Their control and possible elimination offers an opportunity for experiment and at times for the fundamental study of the relation of organisms to their environment.

The present day organization of the American farm creates well-defined problems in engineering. Farm power, the relative cost and effectiveness of animal and mechanical power, the relation of tillage machinery to soil texture and structure, the illumination and heating of dwellings and outbuildings, ventilation drainage, land clearing and road construction demand inquiry that may range all the way from simple tests to carefully planned research. The requests for these and other inquiries are becoming more and more insistent, and while our rural constituency is often more than generous in its support of agricultural research it is now and then impatient of results. When a new insect enemy or plant disease brings widespread destruction and loss the discouragement among the producers reacts unfavorably on the agricultural colleges and experiment stations, as well as on the Federal Department of Agriculture. The farmer facing ruin, like the cotton grower in the boll weevil infested territory, must have immediate relief and he expects nothing short of the impossible. But on the whole the farmers are loyal to the research institutions. Time is bringing to them a keener discrimination and the understanding that knowledge can be gained only slowly and painfully by following devious and thorny paths, by discarding much and keeping little. They are more appreciative of the time element in the conduct of important investigations and are willing to tax themselves and to contribute directly from their slender purses toward the time-consuming and rigid culling of facts and principles. There is much encouragement for the student of agricultural science in the broadening outlook of the nation, in its concern for the conservation and upbuilding of our land and crop resources. Well beyond the pioneering stage of exploitation and of empirical practice, we are moving forward to rising levels of production, and

with the help of the trained man we are trying to look beneath the surface. We are reaching out into new fields of research endeavor, we are gathering facts and deductions from the outlying regions of science, we are multiplying and sharpening the tools of research workers, and are constantly widening the perspective of agriculture. Much is being given to agricultural research and much is expected from it. Will the Department of Agriculture and our colleges and experiment stations measure up to the task? The answer must be an affirmative one if we are to gauge future achievement by the more ample facilities for study at our colleges and universities and the zeal, the integrity and the humility of our research workers.

J. G. LIPMAN

RUTGERS COLLEGE

FRITZ WILHELM WOLL

DR. FRITZ WILHELM WOLL, professor of animal nutrition in the University of California, well known as a writer on animal feeding and dairy subjects, died at Berkeley on December 6.

Dr. Woll received his early education in Christiania, Norway, obtaining the degree of Ph.B. from the Royal Fredericks University, Christiania, 1883. Later, degrees of M.S. and Ph.D. were conferred by the University of Wisconsin in 1886 and 1904, respectively. After graduation as Master of Science at Wisconsin Dr. Woll was appointed second assistant chemist, Wisconsin Agricultural Experiment Station, 1887, and rose to the position of chemist for the station in 1897. He became professor of agricultural chemistry, University of Wisconsin, in 1906, which position he held until 1913, when he was called to the University of California as professor of animal nutrition, holding that chair until his death.

He was the author of many works, each of which has been reissued in a number of editions; among these may be mentioned:

"A Book on Silage," revised edition, 1900.

"A Translation of Modern Dairy Practice" (from Swedish of G. Grotenfelt), 1894, third edition 1905.

"A Handbook for Farmers and Dairymen," 1897, sixth edition, 1914.

"Testing Milk and Its Products" (with Professor E. H. Farrington), 1897, twenty-fourth edition, 1918.

"Productive Feeding of Farm Animals," 1915, second edition, 1916, third edition, 1921.

"Feed Manual and Note Book," 1917.

Dr. Woll accomplished a large amount of scientific work while at the universities of California and Wisconsin, as is well shown by the series of important and timely bulletins of the respective agricultural experiment stations. He was also an extensive contributor to technical publications and agricultural and dairy papers. His articles were always replete with valuable aid to dairymen and feeders in general.

It is primarily due to the untiring efforts of Dr. Woll that the cow-testing associations of so much value and importance to the dairy industry of California have been developed and placed on a business-like and permanent basis.

He was a member of many agricultural and scientific societies, including: Wisconsin Academy of Sciences, Arts and Letters; Society for the Promotion of Agricultural Science; American Society for Animal Production; Association of Official Agricultural Chemists, (president, 1909-11); American Dairy Science Association; Sigma Xi; Member International Jury Panama Pacific International Exposition, 1915.

The passing of Dr. Woll is a great loss to the University of California and to the animal industry of the whole country.

SCIENTIFIC EVENTS

INTERNATIONAL TELEPHONY

THE inaugural address delivered by Mr. Frank Gill, as president of the British Institution of Electrical Engineers, as reported in the London *Times*, discussed the problem of establishing efficient international telephonic communication among the different countries of Europe, including Great Britain.

He expressed the opinion that, given adequate facilities, there is traffic waiting to be handled between the cities of Europe, and urged that there are weighty reasons for providing those facilities, such as the present necessity for improving the relations between nations, in addition to the normal commercial advantages. So far as distance is concerned,

there is no engineering difficulty in constructing and operating lines at commercial rates to give satisfactory speech between any one and any other part of Europe; and he illustrated this statement by pointing out that between Brussels and Athens, or Paris and Constantinople, the distance is about the same as between New York and Omaha, between which calls can be made at any time, and that the direct distance overland from London to Delhi is about the same as from Key West in Florida and thence to San Francisco and Los Angeles, over which distance calls can be made regularly.

Results of this kind, however, require the use of elaborate technical devices, such as loading coils and repeaters. Formerly a long-distance telephone line consisted merely of a pair of copper wires, which with comparative ease could be kept in good order by independent maintenance units situated along its length. But now that simple structure has vanished, the plant is more complicated, the various parts are interdependent, and it is no longer possible to consider maintenance of each part solely as a sectional matter, since what is done at one place may cause serious effects at another.

Present knowledge can secure great increase in the distances spoken over, in the number of channels of communication afforded by one pair of wires, and in the cheapness, security and speed of the service, but a price must be paid for these advantages in the shape of definite and unified planning throughout the area to be covered, with unity of maintenance and of operation. In Europe, however, there are about forty self-contained local telephone operating organizations, which, though for through service they must function as a whole, are without coordination, standard practice or common technique of construction, maintenance and operation; and the through service is meager in quantity, slow and inefficient.

The through business must be handled as a complete unit, if it is to be efficiently done, and to Mr. Gill the correct course appeared obvious—to depute a body to do for all the European nations what no one nation can do for itself. Such a body, he suggested, might consist of a single company working under licenses from the various governments, or of a company or commission in which they would be the sole stockholders, which would operate all the through business both within and between the various countries of Europe. As another alternative, frankly of a temporizing nature, he suggested that all the telephone authorities should form an association and hold an early conference to study the problem in detail.

THE INTERNATIONAL COMMITTEE ON MARINE FISHERIES INVESTIGATION

THE International Committee on Marine Fisheries Investigations held its fourth meeting in Washington recently, the members present being William A. Found and Dr. A. G. Huntsman, representing Canada, and Drs. H. F. Moore, R. E. Coker and H. B. Bigelow, representing the United States. Dr. J. Playfair McMurrich, of the Canadian delegation, and Dr. James Davies, the Newfoundland delegate, were unable to attend.

The *Fisheries Service Bulletin* states that the permanent organization of the committee was completed by the election of Dr. Moore as permanent chairman, Dr. Huntsman having been elected permanent secretary at the meeting in Montreal in May. It was announced that the French government, by reason of its investigations incident to the fishery on the Grand Banks from the island of St. Pierre Miquelon, was interested in the work of the committee and would apply for representation.

The records of current drift-bottles released by Canada and the United States on the coast north and east of Sandy Hook were discussed, and the preparation of a report assigned to a committee consisting of Messrs. Huntsman and Bigelow.

Plans were made for the initiation during the coming spring of experiments in tagging cod, haddock and other commercial species of importance in the fisheries of Canada and New England, and tentative arrangements were made for the conduct of other investigations of these fish. The committee adjourned to meet in Toronto in May.

COLLOID CHEMISTRY AT THE UNIVERSITY OF WISCONSIN

THE department of chemistry of the University of Wisconsin desires to call attention to the program for colloid chemistry which will be conducted by Professor The Svedberg

during the coming semester (commencing February 1, 1923) and summer session (commencing June 25, 1923).

Professor The Svedberg, of the University of Upsala, will be in residence at the university from February 1 to August 5. He will give two lectures a week on the general theory of colloids and will direct the experimental researches of a number of graduate students during the second semester. In the summer session the course of lectures given during the second semester will be repeated. Every necessary facility will be provided for the successful prosecution of researches. Those desiring to work under Professor Svedberg's personal direction, either during the second semester or during the summer session, should communicate promptly with Professor J. H. Mathews, chairman of the department, since only a limited number can be accommodated. The opportunity of hearing Professor Svedberg's lectures and doing work under his direction during the summer session will appeal to a great many professors and instructors at other educational institutions. A considerable number have already signified their intention of embracing this opportunity.

Professor Svedberg will also conduct a seminary in colloid chemistry which will meet weekly during the second semester. The first half will be devoted to general theory and the second to biological applications of colloid chemistry. In the latter half of the work he will be assisted by Professor Elmer Sevringhaus, of the department of physiological chemistry. Admission to the seminary will be open to chemistry students who have had a course in physical chemistry and who possess at least an elementary knowledge of the theory of colloids, and to advanced workers in the biological sciences.

From June 12 to 15 inclusive a national symposium on colloid chemistry will be held at Madison to which all scientists interested in colloid chemistry are invited. A program of exceptionally interesting papers is now being formulated, and definite assurance of the attendance of nearly all of the most prominent American workers in the colloid field has already been given. About twenty papers will be presented by the authors in person and there will be ample time for thorough discussions. These discussions will be led by Professor Svedberg. More detailed information concerning the program of papers to be presented will appear later in these columns.

DISTINGUISHED SERVICE AWARDS TO CHEMISTS

THE men listed below, formerly connected with or assigned to the Chemical Warfare Service, as we learn from the *Journal of Industrial Chemistry*, have been awarded distinguished service medals for exceptionally meritorious and distinguished service in the following particulars:

Raymond F. Bacon, colonel, C. W. S., chief of Technical Division, A. E. F. Untiring energy, marked scientific attainment and comprehensive technical knowledge in the organization and operation of laboratory units and proving-ground tests.

Karl Connell, major, Medical Corps. Exposed himself unhesitatingly to highest concentrations of deadly gases while working with experimental models and masks. Invented, tested out and perfected a new type of gas mask superior to any then in existence.

Harry L. Gilchrist, lieutenant colonel, chief of the Medical Section, C. W. S., A. E. F. Not only performed services of the utmost value, both to the Medical Department and the Chemical Warfare Service, but developed a degassing unit for treating men exposed to mustard gas which proved so successful that it was adopted for the entire American Expeditionary Forces.

Byron C. Goss, lieutenant colonel, C. W. S., chemical adviser, office of chief, C. W. S., later as chief gas officer of First Corps, and finally, of Second Army. Exceptional ability and wide knowledge of gases; connected with practically every battle in which American troops were engaged.

Joel H. Hildebrand, lieutenant colonel, C. W. S., commandant, C. W. S., Experimental Field, A. E. F. Profound knowledge of chemistry, coupled with rapid grasp of military problems, enabled him to render services of value in determining the best means of using gas and gas materials in the field.

Edward N. Johnston, colonel, Corps of Engineers, assistant to chief, C. W. S., in France from June to December, 1918. Ability of high order in supervision of operations of all gas troops. Later also, to June, 1919, as acting chief of C. W. S. abroad, showed keen business ability and sound judgment in closing the chemical warfare

activities of the American Expeditionary Forces.

Gilbert N. Lewis, lieutenant colonel, C. W. S. Secured first-hand data in uses and effects of gas and submitted reports of such value that they became fundamentals upon gas warfare policies of the American Expeditionary Forces. As chief of the Defense Division, he was instrumental in securing more effective gas production, especially mustard gas.

Augustin M. Prentiss, major, General Staff Corps, then major, C. W. S. Knowledge of supplies and material, especially in proper choice of gases, gas shells and other materials used by gas troops and artillery.

John W. N. Schulz, colonel, Corps of Engineers, representative, C. W. S., at general headquarters. Service in the solution of many problems relating to the offensive use of gas and also in planning more effective method for issuance of equipment and training in gas warfare. Later, as chief gas officer of First Army, had entire responsibility of gas warfare in that army during St. Mihiel and Meuse-Argonne offensives.

Richmond Mayo-Smith, lieutenant colonel, C. W. S., chief of Supply Section. Built and administered supply organization consisting of twelve seaport, intermediate and front-line depots, which fully met at all times the demands of chemical warfare supplies which active operations brought upon the service.

Joaquin E. Zanetti, lieutenant colonel, C. W. S., chief liaison officer, C. W. S., with French forces. Familiarity with French language and methods and superior technical ability enabled him to gather an enormous amount of detailed information concerning the manufacture, handling and use of gases.

SCIENTIFIC NOTES AND NEWS

PROFESSOR ALBERT EINSTEIN, of the University of Berlin, has been elected a member of the Russian Academy of Science.

THE Accademia dei Lincei has elected as foreign members the mathematicians Professors E. T. Whittaker of the University of Edinburgh and E. Landau of the University of Göttingen.

THE Indian Mathematical Society has elected to honorary membership Professor G. A. Miller, of the University of Illinois.

AT the meeting of the Royal Geographical Society on December 11, the French ambassador, on behalf of the Société de Géographie of Paris, presented a gold medal to Professor J. W. Gregory for his geographical work in East Africa. Professor Gregory afterwards read a paper on the results of his recent journey in the mountains of Chinese Tibet.

PROFESSOR FREDERIC S. LEE, of Columbia University, has been elected president of the New York Botanical Garden.

AT the Toronto meeting of the American Biochemical Society officers for 1923 were elected as follows: *President,* Professor Philip A. Schaffer, Washington University; *vice-president,* Professor H. C. Sherman, Columbia University; *secretary,* Dr. Victor C. Myers, New York Medical School, and *treasurer,* Dr. W. R. Bloor, Rochester.

AT the fourteenth meeting of the Paleontological Society held at Ann Arbor on December 29 and 30, in affiliation with the Geological Society of America, the balloting for officers resulted as follows: *President,* T. W. Vaughan, Washington, D. C.; *vice-presidents,* W. A. Parks, Toronto, Ontario, W. H. Twenhofel, Madison, Wis., and O. P. Hay, Washington, D. C.; *secretary,* R. S. Bassler, Washington, D. C.; *treasurer,* R. S. Lull, New Haven, Conn.; *editor,* Walter Granger, New York City. Twenty-five papers covering the various sections of paleontology were presented and discussed and fourteen new members were elected, making the total membership of the society at the end of 1922 as 228.

THE Potato Association of America has elected Dr. W. H. Martin, of the New Jersey Experiment Station, as its president; G. C. Cunningham, of the Dominion Department of Agriculture, vice-president, and William Stuart, of the U. S. Department of Agriculture, secretary-treasurer.

DR. EUGENE L. OPIE, professor of pathology at Washington University School of Medicine, has been awarded a fund of $3,000, by the National Tuberculosis Association of New York City, for the further development of his work on tuberculosis.

DR. IRA N. HOLLIS, president of Worcester Polytechnic Institute, has retired as a member of the council of the American Society of Mechanical Engineers. Dr. Hollis, who has just completed six years of service, one as president and five as past president, is suc-

ceeded by Dean Dexter S. Kimball, of Cornell University.

OWING to his appointment as British ambassador at Paris, Lord Crewe, who recently accepted the presidency of the British Science Guild, has had to withdraw from this office, but has become a vice-president of the guild and also a member of the committee being formed to make a special appeal for adequate funds to maintain and extend the activities of the guild on behalf of British science. Lord Askwith has consented to accept the presidency of the guild and the lord mayor of London has become a vice-president.

PROFESSOR S. WINOGRADSKY, former director of the imperial institute for experimental medicine in Petrograd, has been appointed chief of a newly organized division of soil microbiology at the Pasteur Institute.

DR. GABRIEL MALDA, head of the national public health department of Mexico, has been appointed vice-president of the National Academy of Medicine.

JOHN OLIVER LA GORCE, associate editor of the *National Geographic Magazine* and trustee of the National Geographic Society, has been elected a vice-president of the society. Mr. La Gorce has been associated with the National Geographic Society since 1905 and has traveled extensively abroad in its interests.

DR. N. H. DARTON, of the U. S. Geological Survey, has returned to Washington after nearly two years' field work completing the geologic map of Arizona for the State Bureau of Mines. While in Arizona the State University conferred on Mr. Darton the honorary degree of doctor of science in recognition of his work on the geology of the southwest.

JOHN F. WORLEY, professor of transportation engineering at the University of Michigan, at a salary less than $5,000, has refused a salary of $25,000 with a large manufacturing concern.

DR. GEORGE H. KIRBY, professor of psychiatry at the Cornell Medical College, has been elected the first president of the recently organized New York Society for Clinical Psychiatry.

THE section on general medicine of the College of Physicians of Philadelphia have elected the following officers for 1923; Dr. Herman B. Allyn, *chairman*, and Dr. Edward J. G. Beardsley, *clerk*. The executive committee of the section, as appointed by the president of the college, consists of Dr. David Hiesman, *chairman*, Oliver H. Perry Pepper and Dr. John H. Musser, Jr.

THE first of the annual series of lectures by the Omega Chapter of the Society of Sigma Xi of Ohio State University was held on October 15, the lecture being delivered by Mr. Thomas Midgeley, Jr., and T. E. Boyd, fuel engineers of the General Motors Research Corporation, upon the subject, "The chemical control of gaseous detonation." The new officers of the Omega Chapter for the current year are James R. Withrow, professor of industrial chemistry, *president;* Edward Mack, assistant professor of physical chemistry, *secretary*, and Thomas Phillips, professor of agricultural chemistry, *treasurer*.

AT a meeting of the Western Society of Engineers held on January 5 in Chicago, Dr. C. A. Kofoid, professor of zoology in the University of California, gave an address on "Preventive medicine and sanitation in relation to human efficiency." In addition, two films were shown: "Unhooking the Hookworm" and "Exit Ascaris," loaned for the occasion by the Rockefeller Foundation and the U. S. Department of Agriculture, respectively.

DR. W. J. HUMPHREYS, as retiring president of the Washington Academy of Sciences, gave an address, on January 9, at the Carnegie Institution, on "The murmur of the forest and the roar of the mountain," in which he discussed several peculiarities of mountain meteorology.

DR. H. W. WILEY, director of the Bureau of Foods, Sanitation and Health of *Good Housekeeping*, gave an address before the American Academy of Applied Dental Science at the annual meeting at Miami, Florida, on January 10, on the "Prophylactic and therapeutic properties of foods."

THE one hundredth anniversary of Pasteur's birth is commemorated in New York at the Academy of Medicine by an exhibit showing the advances in medicine and surgery due to

him; the American Museum of Natural History typified by its exhibit the debt which science in general owes to him. There will be a meeting held at the Town Hall, 121 West Forty-third Street, on Sunday evening, January 28, 1923, at 8:15, when the ambassador of France will preside. The speakers and their topics will be Dr. Nicholas Murray Butler, "Pasteur as an educator, patriot and humanitarian"; Dr. John Huston Finley, "The debt of industry and science to Pasteur," and Dr. George David Stewart, president of the Academy of Medicine, "What medicine and surgery owe to Pasteur." No charge will be made for admission and the public is invited to attend.

ON *December* 19 and 20, Marquette University celebrated the Pasteur-Mendel centenary. The first day two lectures were delivered by Professors Locy and Guyer, of Northwestern University and the University of Wisconsin, respectively. The following day lectures were given to the students by members of the faculty dealing with the various aspects of the lives of Pasteur and Mendel. In the evening a banquet was held at the Hotel Pfister, at which time Dr. Joseph Jastrow spoke on mental heredity. The university plans to have the various speeches incorporated in a small volume for distribution.

MR. EDWARD DEGEN, sometime of the staff of the British Museum and the Melbourne Museum, died on December 10, aged seventy years.

THE Marquis of Cerralbo, well known for his achievements in the field of prehistoric research in Spain, has died at the age of seventy-seven years.

PROFESSOR L. L. THURSTONE, head of the department of education and psychology at Carnegie Institute of Technology, Pittsburgh, has been appointed director of research in charge of the Bureau of Personnel Service. The bureau is to be affiliated with the Institute of Government Research, and has been privately endowed subsequent to appeals for its establishment from the United States Civil Service Commission. An advisory board of five members of the national civil service commissions will supervise the operation of the bureau. Mr. Thurstone and his associates will immediately take up the study of the selection, transfer and promotion on a basis of merit of all public service employees; classification of the positions in public service; methods of rating efficiency; reorganization of training courses for federal employees; recommendation of postal clerk and carrier tests; organization and procedure of district offices of the Civil Service Commission, and various other personnel problems outlined by the advisory board. Its field of work covers investigations of state and municipal employee problems in addition to those of the federal service.

THE work of the American Scenic and Historic Preservation Society during the past year was reviewed by Dr. George F. Kunz, its president, at the twenty-eighth annual meeting of the society held at the American Museum of Natural History on January 5. The business meeting was followed by a lecture given under the joint auspices of the society and the museum by Carl E. Akeley on "Beautiful Africa." Dr. Kunz referred briefly to the administration by the society of six state properties—Phillipse Manor Hall, at Yonkers; Stony Point battlefield; John Boyd Thacher Park, west of Albany; Fort Brewerton Reservation, at the foot of Oneida Lake; Battle Island Park, on the Oswego River, and Letchworth Park, on the Genesee River. Plans for the utilization of Diamond Island, at Lake George, which was bequeathed to the society by Mrs. George Foster Peabody, are being made by a committee of which Charles J. Peabody is chairman and George Foster Peabody is one of the members.

DR. FOREST B. H. BROWN, botanist of Bishop Museum, and Dr. Elizabeth Brown, research associate in botany, have recently returned from the Marquesas Islands, where two years have been spent as members of the Bayard Dominick Expedition. All inhabited islands of the group were visited with a view to a thorough survey of the flora. Much new information has been obtained bearing on the geological history of the Pacific insular flora and a study of the food, ceremonial and medicinal plants has thrown new light on the migrations of the Marquesans and of other branches of the Polynesian races. Mrs. Brown gave special attention to the remarkably rich Cryptogamic flora.

The Swedish government has appropriated 60,000 crowns toward the expenses of Dr. H. Lundborg's Institute for Biologic Research on Heredity and Racial Characteristics at Upsala. Dr. Halkrantz has been appointed professor of research on heredity, and Dr. Nillsson-Ehle, professor of statistics. An experimental section for biopathology is planned, and a museum for the collection of data on hereditary factors.

The Stanford University Medical School announces the forty-first course of popular medical lectures as follows: January 12, "Building up resistance to disease: an individual and a community problem," Dr. Philip King Brown; January 26, "Gifted children," Dr. Lewis M. Terman, professor of psychology, Stanford University; February 9, "The problem of the delinquent child," Mr. J. C. Astredo, chief probation officer of the juvenile court; February 23, "The care of the dependent child," Miss Katherine Felton, general secretary, Associated Charities; March 9, "Modern views on dental hygiene in childhood," Dr. Guy S. Millberry, dean of the College of Dentistry, University of California Medical School; March 23, San Francisco's health program for children: "The medical aspects," Dr. William C. Hassler, health officer, San Francisco; "The educational aspects," Mrs. C. W. Hetherington, director of health education, Board of Education.

UNIVERSITY AND EDUCATIONAL NOTES

Princeton University has received a gift of $100,000 from Henry Lane Eno, research associate in psychology, and $25,000 from an unnamed alumnus, for the construction of a psychological laboratory.

By the will of the late William G. Vincent, a fund of $60,000 for establishing a chair of tropical disease at Tulane University of Louisiana School of Medicine, New Orleans, will eventually be available; also, $30,000 for the erection of an isolation building for the Charity Hospital, New Orleans.

On the night of December 16 Robinson Hall, the main recitation building of Albion College, Albion, Mich., was almost totally destroyed by fire. The biological equipment and natural history museum suffered practically a complete loss. The department of biology is temporarily housed in the chemical laboratory. Plans are being made to arrange new quarters for the department to be in readiness for occupation early next fall.

Dr. M. A. Brannon, president of Beloit College, formerly professor of biology at the University of North Dakota, has become chancellor of the University of Montana.

William Mayo Newhall, of San Francisco, and Herbert Hoover, whose home is on the Stanford campus, have been reelected members of the board of trustees of Stanford University to succeed themselves. The Stanford trustees are elected for ten-year terms. Mr. Newhall was also reelected to the presidency of the board.

Dr. A. J. Goldfarb has been promoted to be associate professor at the College of the City of New York.

Dr. Samuel R. Detwiler, who for the past three years has been an associate in anatomy at the Pekin Union Medical College in China, which is under the management of the Rockefeller Foundation, has been appointed assistant professor of zoology at Harvard University, to serve during the second half of the current year. Before going to China, Dr. Detwiler was an instructor in zoology at Yale.

Dr. Hans Zinsser, since 1913 professor of bacteriology at Columbia University and bacteriologist of the Presbyterian Hospital, has been elected as professor of bacteriology and immunology in the Harvard Medical School. Dr. Zinsser, who holds the bachelor and master degrees from Columbia University, as well as the doctorate in medicine (1903), will assume the work in Boston in the autumn.

DISCUSSION AND CORRESPONDENCE

THE PROPOSED ROOSEVELT-SEQUOIA NATIONAL PARK AND THE BARBOUR BILL

In Science for December 22, 1922, on pages 705 to 707, appears an article by Dr. W. G. Van Name headed "A Menace to the National Parks." Those who are familiar with the active campaign which Dr. Van Name has

been carrying on against the Barbour bill will take the article at its true valuation. But many other readers of SCIENCE unfamiliar with the facts may receive the wrong impression.

Before starting on a single-handed crusade against a bill which has been carefully considered by competent Government authorities, and endorsed by practically all prominent organizations and individuals interested in the matter, it would have been well to ascertain the facts. This precaution Dr. Van Name does not seem to have taken. The very first statement which he makes is incorrect. The American Association for the Advancement of Science is not represented on the National Parks Committee.

The support of the Barbour bill comes, not from those who do not understand "what the bill will do," but on the contrary, from those who have most investigated the matter. Dr. Van Name's attacks have been effective only where the facts were not known.

The resolution quoted is so unfair and so contrary to the best conservation interests that it has called forth a number of protests, as a result of which the Conservation Committee of the San Diego Society of Natural History has decided to recommend no further action against the bill for the present.

It seems particularly ill advised to speak of the efforts of the Forest Service and National Park Service, each working in the best interests of the public, as a "factional dispute" and "internecine strife." The use of such language displays ignorance or disregard of the broader principles underlying the national parks and national forests, and fosters disagreement among conservationists, to the detriment of both the parks and the forests. The drawing of the proposed boundaries required the adjustment of conflicting desiderata in the best interests of all. We cannot both keep our cake and eat it. There is no more justification for locking up vitally needed resources in a national park with no scenic or other valid claim than there is for attacking the parks in order to exploit them for selfish gain.

National parks are created in order to preserve certain scenic or other features of *national* importance. Since these parks must be kept free from commercial use, the features must be of such outstanding interest as to justify abandoning the resources included within the boundaries of a park. The Sequoia National Park was created in order to preserve the giant redwoods remaining in public control. Unfortunately a large portion of these trees had already passed into private hands; the trees on interior holdings can be cut whether they are surrounded by a national park or a national forest. The publicly owned redwoods will be just as safe under the Forest Service as under the National Park Service. The Forest Service, under its policy of the highest use of all resources, has consistently protected the sequoias under its jurisdiction as being of far more value to the public as monuments of nature's handiwork than as sawn lumber. If further security than the public commitment and consistent policy of the Service were necessary, the redwood groves left outside of the new boundaries could be made National Monuments. Once the protection of the sequoias has been assured, there is no justification for retaining the southern half of the present Sequoia Park. This area is three quarters open hillside of no particular scenic attraction, but of great value for grazing.

The strip of the Yosemite which the National Park Service has asked to have eliminated has been giving the park authorities constant trouble because they have been unable to exclude grazing without undue expense. This is purely a matter of efficient administration; the timber is unimportant and does not enter into the question as Dr. Van Name implies.

Dr. Van Name says (p. 706, first column), "Designs on the fine forests of the national parks are not confined to those of the Sequoia Park." He is laboring under the impression that the Forest Service is deliberately scheming to gain control of all timber on the national parks for exploitation, and that the supporters of the Forest Service are its tools or its dupes. He has stated that the Service is the bitterest and most merciless enemy of the national parks, and has attributed the origin of the Barbour bill to a sinister plot between the Forest Service and the lumber-

men. This firmly rooted delusion seems to be the moving force in Dr. Van Name's opposition to the Barbour bill.

The statement near the bottom of page 706, first column, about the forests of the Pacific states will be recognized by those familiar with these forests as wholly misleading. He says, "The immense trees of those forests * * * * * were never found except in tracts of limited extent where they had good soil and other conditions and had escaped serious fire damage for long periods. Those few that still survive are mainly in the hands of the lumber interests and a few years will see the last of them." Obviously he has never traveled through the national forests of the Sierra Nevada Mountains where for mile after mile one passes beneath giant sugar pines, western yellow pines, Douglas firs and incense cedars. Nor has he seen the stands of immense Douglas fir, western hemlock and western red cedar on the national forests of Washington and Oregon. True, these large trees will eventually be cut, such of them as survive storm and decay. But has Dr. Van Name never heard of the Mount Rainier National Park with its primeval forests of Douglas fir and associated species, and of the Yosemite with its Sierra forests of sugar pine and other trees?

The Forest Service is in complete sympathy with the movement for preserving areas of virgin forest for esthetic or scientific reasons. Along lakes and much used routes of travel provision is made for leaving sufficient untouched forest to maintain the natural beauties and charm. Undoubtedly, sample tracts of the various kinds of forest will be preserved for scientific and educational purposes.

When the Barbour bill, in its original form permitting water power development, came up for a hearing before the Committee on Public Lands of the House of Representatives, the strongest statement in favor of complete preservation of the national parks was made by Colonel Greeley, chief of the Forest Service. The bill was amended to exclude water power, and obtained the support of the National Parks Committee and other friends of both parks and forests.

The reasons why the Barbour bill has secured such widespread support, outside of the water power interests, may be briefly stated.

There will be added to the already existing Sequoia National Park 961 square miles of land now in a national forest, and there will be returned to the national forest 105 square miles. This represents an exchange very favorable to the national park. As mentioned above, the sequoia groves placed under the jurisdiction of the Forest Service will be amply protected; the land eliminated is about three fourths open and without scenic attractions.

On the other hand the land added to the National Park contains *more publicly owned redwoods exceeding ten feet in diameter than the area returned to the national forest.* The present Sequoia Park contains 1,214 of such trees, and the Roosevelt-Sequoia Park will contain 1,304, a net gain of ninety trees, besides those outside the boundaries which will still be protected. Aside from the giant redwoods, the 961 square miles to be added contain three or four times as much of the main forest belt, at from 4,000 to 9,000 feet elevation, as the area eliminated, with larger and finer trees. The fact that these trees may be located in mountains difficult of access for logging operations, and may therefore be of little commercial value, does not detract from their scenic and scientific interest.

The jog in the boundary, against which Dr. Van Name protests, was made to leave out lands which do not properly belong in the Park. How this perfectly natural condition, over which obviously man has no control, can injure the new Park is difficult to see.

The Roosevelt-Sequoia National Park will contain, in addition to Mt. Whitney, Mt. Tyndall, and other magnificent peaks, the superb canyons of the Tehipite and Kings River, considered by many as equal in grandeur to the Yosemite. This fact Dr. Van Name has persistently ignored. Water power interests are eager to dam and flood these canyons and have already filed applications for this purpose. Dr. Van Name's activities, though doubtless from an entirely different motive, play directly into the hands of the water power interests and other enemies of the National Parks. If he should be successful we will see these beautiful canyons ruined by dams, conduits, power lines, etc., instead of included in one of our finest National Parks.

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THE PALEOPATHOLOGY OF THE FOSSIL INVERTEBRATES

THE recent volume by Edgar Dacqué, professor in the University of Munich,[1] gives some interesting evidences relating to the paleopathology of the fossil invertebrates, but are so hidden under the misleading title of the book that there is need of calling especial attention to them for those interested in ancient evidences of disease.

His discussion of matters relating to paleopathology is given under two headings: (1) Epökie, Parasitismus, Symbiose, pp. 457-476. (2) Regeneration, pathogene Schalen, Häutung, pp. 693-703. Dacqué finds it necessary to discuss the meaning of the unusual term, *Epökie,* and one wonders why he did not use some well-known term, of which there are several, with the same significance. He defines the term, Epökie, as restricted to those cases in which an animal lives attached to the outside of another living animal. He points out the difficulty of properly interpreting these evidences which are forerunners of diseased conditions.

The treatment of ancient evidences of parasitism is not nearly so complete as that given by Dr. John M. Clarke[2], but is an interesting résumé, illustrated by numerous European and American examples, with bibliographic references. One illustration is very interesting. It is a pathologic carapace of a Cretaceous crab, possibly infested by some member of the family Bopyridæ, which inhabit the branchial cavities of other Crustacea, a habit they are known to have had in the early Pleistocene also. The specimen, derived from the middle Cretaceous of England, was described by Th. Bell in 1862.

[1] "Vergleichende biologische Formenkunde der fossilen niederen Tiere," Berlin, 1921. The cumbersome circumlocution forming the title was evidently used to avoid the repetition of the term *Palæobiologie,* which would be a more exact title but which was adopted by O. Abel in his "Grundzüge der Palæobiologie der Wirbeltiere," Stuttgart, 1912. The two volumes supplement each other in a wonderful way and form a complete and adequate discussion of the paleobiology of all fossil animals.

[2] "Organic Dependence and Disease: Their Origin and Significance," New Haven, 1921.

It is difficult to understand why Dacqué uses the term *pathogene* instead of the more appropriate term *pathologische,* adopted by all other German writers on paleopathology. There is certainly nothing *pathogenic* about either the injured snail or the diseased sand-dollar, from the Oligocene and Miocene respectively, shown on page 699. His studies in regeneration are rather incomplete and largely restricted to European evidences, but on the whole Dacqué's work is to be commended for the attempt to gather evidences relating to the early phases in the evolution of disease. It is worthy of note that such evidences can be satisfactorily sifted only by one who has a wide acquaintance with fossil invertebrates, since rare judgment must be displayed to avoid numerous possible misinterpretations.

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QUOTATIONS

ACROSS THE SAHARA BY MOTOR

THERE is a twofold interest in the attempt to cross the Sahara which is about to be made in Citroën motor-cars. The greater part of the world loves an adventure almost in proportion to its apparent foolhardiness. The brave Frenchmen who next month are to leave the railhead at Tuggurt, in South Algeria, for Timbuctoo are undertaking a journey of over 1,800 miles through a trackless desert, in a region of burning sun by day, of piercing cold at night. Trying to follow the same route by the swifter aeroplane, General Laperrine perished miserably, after a forced landing, and Major Vuillemin succeeded, but only after terrible adventures. Better preparations have been made for the motor-car party. Citroën cars have already been to In Salah and back, a stretch of over five hundred miles, at the northern end of the route, where wells exist and stores of petrol have been placed. At the southern end, along the Niger to Burem, and across the desert to Kidal, a stretch of over three hundred miles, and possibly even farther, stores have been placed in readiness. But for the central "trek" the expedition must be self-dependent. Let our home-fed imagination not picture the desert as a plain of sand, smooth,

except for the ribbing of the wind. It is a rugged country scored by ravines, barred with mountains, and the black rocks show their teeth even in the plains. The shifting sands lie in drifts and beds often most treacherous where they seem most secure, adding to the dangers of the traverse, like wind-blown snow on a rocky slope. And so the mechanical side of the expedition will be watched with an eager curiosity. The cars to be used have the standard ten horse-power engines of the popular Citroën four-seater touring cars. They are fitted with a special gear-box giving a range of speed from two to twenty-five miles an hour, and provided with a ribbed caterpillar of canvas and rubber which has already been tried successfully on loose sand. It will be a striking testimony to the enterprise and workmanship of the Citroën Company if cars of a type produced in bulk and sold at the price of £245 in this country are able to stand a test so severe.—The London *Times*.

SCIENTIFIC BOOKS

American Indian Life, by several of its students. Edited by ELSIE CLEWS PARSONS. Illustrated by C. Grant Lafarge. New York: B. W. Huebsch, 1922.

I DO not now mind confessing that when I first saw this book I felt somewhat suspicious of it, but no sooner had I begun to read it than I became greatly interested and my pleasure increased as I read more of it. We are often told that every man has the making of one good novel. Sometimes this succeeds in being born into the world, usually it does not, but too frequently there is a prolific output of indifferent offspring. There are many books of sympathetic studies in narrative form of native races, which are invaluable as records of alien psychology and of varied customs, but naturally the author confines himself to the people he knows and each book is therefore about the one particular people. This volume is a new departure as it comprises a series of interpretative studies of aboriginal life written by experts. It would not be just to compare the treatment of their subjects by the several authors. Each has its own individuality and it is highly interesting to see how those whom we know personally, or who are known to us by their scientific studies have "let themselves go" and how they reveal themselves in their endeavor to reveal others. One and all are to be heartily thanked for thus giving us of themselves.

It really was a brilliant idea of the Editor, Dr. Elsie Clews Parsons, to induce serious field-workers for the nonce to discard the precise method of a descriptive monograph and to recast their first-hand material in the form of a narrative, which is none the less scientific though presented in a manner which is attractive to all sorts and conditions of men To paraphrase the remark of Professor Kroeber in the Introduction: Every anthropologist with field experience holds in his memory many interpretations, many convictions, as to how his natives feel, why they act as they do in a given situation, what goes on inside them. This psychology is often expressed by the frontiersman, the missionary, and the trader, but it has been very little formulated by the very men who know most. I can well believe, as Kroeber goes on to say, "that the writing of our tale has been a surprise and of value to ourselves. We had not realized how little we knew of the workings of the Indian mind on some sides, how much on others * * * Each author has adhered strictly to the social facts as he knew them. He has merely selected those that seemed most characteristic, woven them into a plot around an imaginary Indian hero or heroine. The method is that of the historical novel, with emphasis on the history rather than on the romance." Indeed all the remarks by Kroeber on the book as a whole are much to the point. May I, however, be forgiven if I demur to one or two statements? He adopts the view current among American anthropologists that "fundamentally one physical type stretches from Cape Horn to Alaska; superficially it is intricately variegated—here with round heads, there with long * * * In fact, it might seem that during ten thousand years the variety of climates and habitats might have succeeded in moulding the Indian into racial types of even greater distinctness than we encounter." I doubt if any European anthropologist would agree that the Lagao Santa type was merely a local variation of the "proto-Mongoloid stock" which gave rise to the typical brachycephalic peoples

of America. The Lagoa Santa type is admittedly an ancient one, and it seems much more probable that it represents a very early migration into America of a non-Mongoloid stock, and probably before the Mongoloids arrived. Again, the dolicho-mesaticephals of the woodlands and plains of North America seem to indicate a different racial movement from that of the western and southern American brachycephals. He also adheres without comment to the popular view that all the culture of Central America and of Peru was rigidly indigenous; but this is not the place to discuss this thorny subject. "British Colombia" is evidently a printer's error which has crept in on p. 10.

After this little grumble I can return to the book itself. A map on page 379 gives the distribution of the tribes described and one sees at a glance how representative they are. An appendix gives a brief account of the distribution of each tribe, and very useful bibliographies. By Mr. C. Grant Lafarge (whose name strangely enough appears only on the title-page, the Editor and Introducer might profitably have alluded to him or his plates), the book is embellished with six colored plates and 19 uncolored, which are explained by the "Illustrator's notes" at the end of the volume. They are mostly of a decorative character, but the artist has evidently been at pains to be accurate in detail and color.

Writing as a teacher of, alas! now long experience, I have no hesitation in stating that this should be the first book to be placed in the hands of a beginner in the study of North and Central American ethnology. When he has read this, he will be able to read textbooks and original treatises with much more profit and comprehension, as he will be equipped with a sympathetic human background which will illumine the more systematic works which he will have to study. There is no better survey of Indian custom and belief for interesting the general reader in the vanished life of the earlier inhabitants of his country. It is to be hoped that the large size and expense of the book will not seriously diminish its sale, for it certainly deserves a wide circulation.

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SPECIAL ARTICLES

AN IMPROVEMENT IN MUSCLE CONTRACTION APPARATUS

ONE of the difficulties encountered in recording a series of muscle contractions is due to the fact that the relaxation phases very seldom happen to stop on the base line; hence the curves are not exactly comparable and it is difficult to make comparisons. It is thus often desirable to be able to adjust the writing point of a lever to the base line on a revolving kymograph and at the same time not otherwise interfere with the experiment. The apparatus described in this paper enables one to do this easily, quickly and accurately. It has been used with satisfactory results on smooth muscles such as the esophagus, stomach, intestine and oviduct of the frog; regions of the esophagus and stomach of the turtle, and the circular muscles of the body wall and intestinal tract of the earthworm.

The principle involved is that of raising or lowering the fulcrum of the writing lever by means of a micrometer screw. This adjustment is of special advantage when stimuli are being made at regular intervals of time and when the stretch of the muscle is considerable or the relaxation phase is slow or long drawn out. By use of this apparatus one is able to make these corrections at will by raising or lowering the writing point to the base line while the kymograph is running.

The main support of the apparatus is the iron bar indicated by letter *A* in figure 1, which may be clamped on to a ring stand. At right angles to *A* are two parallel bars, *B* and *R*. The former and shorter one is rigid and firmly

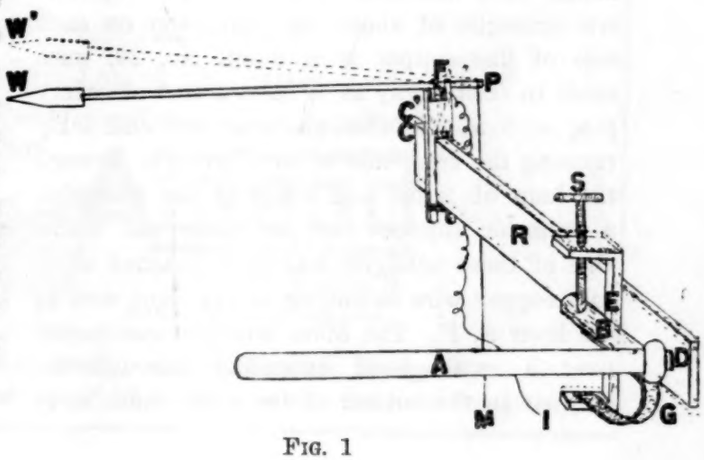

FIG. 1

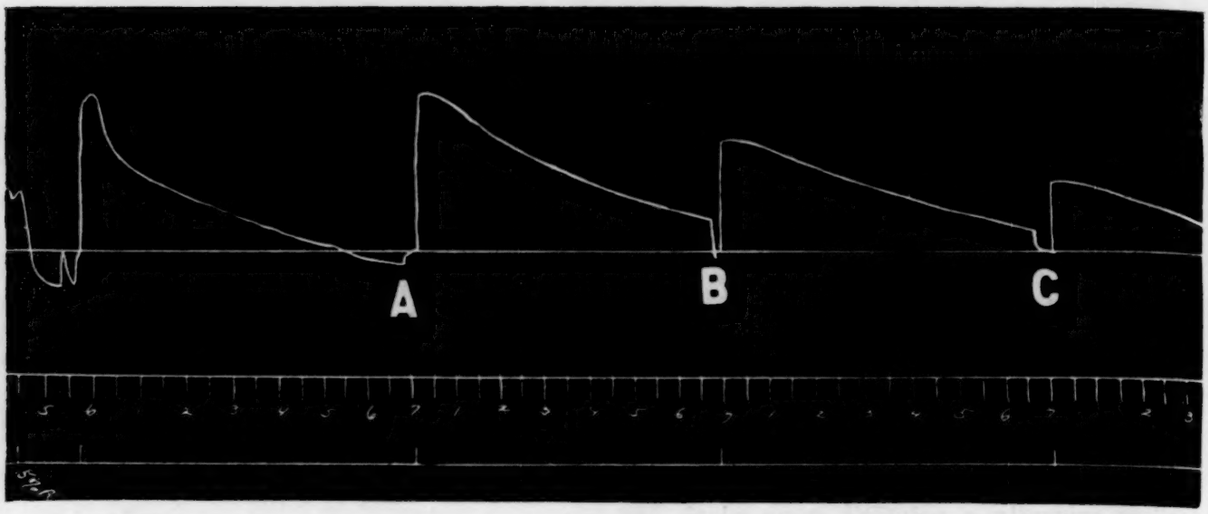

FIG. 2

attached to *A* near its distal end. The latter fits on the distal end of the bar *A* and turns on it as on an axis at *D*. Firmly attached to *R* about one fourth of its length from *D* is a rigid piece *E*, both ends of which are bent at right angles to its main axis. Through its upper end passes a micrometer screw *S*, which is so arranged that when turned clockwise it strikes the bar *B* and thus raises the pieces *E* and *R*. The point *C* is raised to *C'* and hence the fulcrum *F* is also raised. To the lower end of *E* is firmly attached the lower end of a horseshoe shaped steel spring *G*. The upper end of the spring presses against the lower side of the rigid bar *B*. When the screw is turned clockwise, *E* and hence *R* and *F* are raised and the two ends of the spring are forced closer together. When the screw is turned counter clockwise the spring forces the lower end of *E* down, hence *R* and *F* are lowered.

Standardized loops of the muscle to be stimulated were mounted as follows: Two equilateral triangles of about one centimeter on each side of fine copper wire, about No. 24, were made in such a way as to form a sort of safety pin, with a hook-like clasp at one end. By running the free ends of each triangle through the loop of tissue and clasping the triangles, a desirable support for the tissue was made. One of these triangles was then attached at *M* to a copper wire extending to the short arm of the lever at *P*. The other triangle was looped over a small hook extending through the stopper in the bottom of the glass chamber in which the muscle was placed. These supports also served as contact terminals for the electric current, while the short arm of the lever *F P* and the copper wire extending from *F* to *l* completed the circuit.

Figure 2 is a series of curves of a muscle stimulated at regular intervals of seven minutes (by an electrical current of constant strength and duration) showing how the writing point may be adjusted either up or down to the base line, without interfering in any other way with the experiment. In this particular series the muscle consisted of ten segments of the body wall of an earthworm, taken between the sixtieth and seventieth segments back of the clitellum and immediately mounted as described above and immersed in normal sodium chloride solution. Eight minutes after mounting, the normal sodium chloride was removed and 0.5 per cent. ethyl alcohol added; after 1¼ minutes the electrical stimulus was applied and likewise after three successive intervals of seven minutes each. Adjustments of the writing point were made at *A, B* and *C,* immediately preceding the limit of the seven minute time interval between the stimuli. These corrections may be made either up or down with equal ease. By this means the curves are more accurately standardized and more nearly comparable from the fact that each starts from the base line.

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